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ABSTRACT

This report examines the effects of feedback, through the use of computer-assisted instruction, on the problem-solving abilities of "at-risk" college students, i.e., students identified as academically disadvantaged. Study subjects were 30 male and female undergraduate students aged 18 to 23 years. The study used two computer-assisted instructional modules and a posttest. Information was presented to the students in sections of five screens of text, followed by five multiple choice questions with four alternatives. This cycle continued for a total of 15 screens of text and 15 questions. The difference between the two instructional methods was the type of feedback (knowledge of correct response or inductive) presented to the learner. The knowledge of correct response (KCR) feedback gave either a "right" or a "no, try again" response to learners, while the inductive feedback provided learners more information or rules leading to the correct answer. The posttest contained 21 questions not previously given in the instructional modules. Findings indicated mean scores for the 21-item posttest of 14.4 for the KCR treatment and of 13.95 for the inductive treatment indicating no performance advantage between the two feedback methods. (Contains 23 references.) (GLR)

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The effects of feedback on the problem solving ability of academically at-risk students

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INTRODUCTION

With the increased use of computer-assisted instruction, instructional designers should continue to acentuate the most positive and advantageous aspects of computer-assisted instruction; two of which include the ability to give immediate feedback and to make instruction more individualized. This study will examine the effects of feedback on the problem solving abilities of 'at-risk' students. When investigating the effectiveness of inductive feedback on the problem solving ability of students who are identified as academically disadvantaged, there are three elements that must be discussed: feedback, problem solving, and academically disadvantaged students.

Computer-assisted instruction can employ feedback strategies that will improve a student's ability to solve problems; no matter what genre. When we speak of students, we must be inclusive of students of high achievement levels and those students who are at-risk of academic failure.

Feedback

Feedback is defined as any of numerous procedures that are used to tell a learner if an instructional reponse is right or wrong (Kulhavy, 1977). Schimmel (1988) identifies four types of feedback; confirmatory, correct response, explanatory, and bug-related. Confirmatory feedback confirms whether the learner's answer is correct or incorrect. Correct response feedback presents the correct answer to the learner. Explanatory feedback exists in two forms; specific view and general review. Specific view feedback presents the learner with a step-by-step solution to an incorrect problem with the last step omitted. General review feedback presents the learner with summary statements of the instructional content followed by the learner's incorrect answer. Bug-related feedback corrects a learner's faulty mental model of a procedure or concept. According to Roper (1977), there are only two major types of feedback; knowledge of results (KR) and knowledge of correct response (KCR). Later researchers such as Clariana (1991) are looking at answer until correct (AUC) and delayed feedback which tend to be focused on feedback regarding incorrect responses. Answer until correct feedback instructs the learner to select the correct answer after an incorrect response has been chosen. The concept of delayed feedback allows time for the incorrect answer to be removed or replaced and for the correct reponse to be substituted into the learner's mind. The hypothesis is that time will allow the learner to "forget" their initial response which will reduce the interference effects.

Because researchers have chosen to describe feedback in a variety of ways, confusion of the terms may occur. All of the types of feedback can be categorized into two groups: response and information feedback. The term response is used in the most general sense refering to a response made by the computer. This response can be immediate or delayed, and identify an incorrect or correct answer as long as the computer responds to the learner's input. The term information corresponds to the information that the feedback provides the learner. This information could range from giving the correct response to providing the learner with strategies to achieve the correct response. Feedback occurs after two types of responses; correct and incorrect. When feedback follows a correct response, it assures the learner that their understanding of the content material is correct. This provides confirmation to the learner that they have achieved performance that is in accordance with the objective of that particular instructional module. Because a correct response doesn't require any cognitive change on the part of the learner, it is not as important as the feedback that follows an incorrect answer. When an incorrect response is given, feedback must remove that incorrect response from the learner's cognitive schema while replacing it with the correct response.

The early research viewed feedback as merely a reinforcer. This idea was supported very strongly by operant psychologists who believed that immediate feedback worked to increase the chances that the learner would make the same correct response in the future. The operant view point is based in the response-strengthing theory, which provides a foundation for much of the research dealing with

knowledge of results feedback (Roper, 1977). Feedback has also been identified as a means of providing information to the learner (Mory, 1992). Information feedback provides the learner with input information needed to correct their incorrect responses. The type of feedback that is given to a learner is essential to the way they view themselves and the information they are studying. Feedback is an important part of instruction that requires more emphasis. We understand that feedback informs a learner about the accuracy of their response as it pertains to the exsting correct knowledge. But, we should also realize that if the learner is not familiar with the material being presented, feedback will provide minimal positive effects. Additionally, what we should try to do with feedback is structure it such that it allows learners to relate existing knowledge with feedback to arrive at a correct response.

Much research has been done investigating the effectiveness of different types of feedback in computer-assisted instruction. The effectiveness of feedback in computer-assisted instruction depends on appropriate information regarding the learner's response, the need for immediate feedback, and the level of the material to be learned (Waldrop et. al., 1986). Two factors that will hinder the potency of feedback are the availability of the feedback and the level of difficulty in learning the material. If the feedback is too obvious and too available, then learners may just copy answers instead of learning. Also, if the content is too difficult then learners will begin to guess or become frustrated with the content.

Problem Solving

Problem solving is defined as a directed cognitive learning process that makes use of previously learned knowledge and cognitive strategies (Duffield, 1991). Because it is a cognitive process, it occurs internally. Before one begins our discussion on problem solving, one must first define a problem. A problem consists of three parts: a goal, a given state, and obstacles. The goal is a statement of the desired situation without the existence of the problem. The given state represents the conditions that exist when the learner begins to solve the problem. The obstacles are the objects that prevent a given state from being transformed directly into its goal state.

Since one has recognized that there are different parts of a problem, one must also realize that there are different types of problems. The three major types of problems are arrangement, transformation, and induction. Arrangement problems give the learner all the elements of the problem and the rules needed to resolve the problem. The learner must arrange the elements in a way that solves the given problem. Transformation problems involve changing elements of a problem through a series of operations. The learner must transform the givens with the use of the rules into the goal of the situation. Induction problems require the learner to discover patterns in a series of examples. The learner is asked to make predictions or hypotheses given the rules and the existence of patterns.

From problem solving, one makes the natural leap to problem solving strategies. A problem solving strategy is a technique that doesn't guarantee a solution, but serves as a guide in the problem

solving process (Gick, 1986). The development and use of problem solving strategies are benefical in education because it provides learners with a strategy for achieving instructional goals without being tied to a particular content area. The area of computer-assisted instruction is being looked upon as the area that can increase the utilization of problem solving strategies. There are two conditions under which computer-based instruction must function. One, teach aspects of problem solving that are transferable to different subject areas. Two, make the learner aware of the problem solving process that is being used. Because problem solving uses previously learned information, the feedback becomes imperative in the problem solving process. Research (Ahmad, 1988) suggests that problem solving modifies the learner's cognitive strategies only if the strategies are instructionally similar to the learner's.

At-risk Students

In discussing the learner population that is referred to in much of the literature as at-risk or academically disadvantaged, this study will use this terminology only to prevent any confusion or ambiguity. All students can be academically disadvantaged if the instruction does not meet their needs. Typically when the literature refers to academically disadvantaged students they are refering to a group that is predominately poor and non-white. Because thirty-five to forty percent of all the children in this country are classified as at-risk (Goodspeed, 1988), researchers should focus their efforts toward this neglected population. The use of computer-assisted instruction

can provide these learners with several advantages. The computer is patient and unbiased. A student remarks (Gross, 1989), "The machine doesn't know I'm black," "It doesn't hate me," "It gives me a second chance." These sentiments are not uncommon. To some stuents computers are viewed as an impartial "facilitator" that doesn't know or care about their income, their skin color, their language, or their gender. Additionally, the computer offers students a chance to succeed and experience academic achievement in the absence of peer pressure while recieving immediate feedback. Along with being successful, the student may have the opportunity to learn in a different way. The computer affords these learners with the opportunity to learn through "private" trial and error or correct their own mistakes without being chastised or ridiculed. Many academically disadvantaged students have learning styles that are different from the traditional expository method of instruction, but computer-assisted instruction can present information in many different ways and through a variety of relavent examples. Through the use of computer-assisted instruction and the implementation of feedback strategies, we can begin to meet some of the needs that are not being met by our current methods of instruction. We are not meeting the educational needs of thirty-five to forty percent of our children, it's time that we began to use our resources to put a halt to this educational neglect.

METHOD

Subjects

The subjects in this study were 30 male and female undergraduate college students between the age of 18 and 23. These students were enrolled at a large northeastern university and were also participants an academic assistance program, which provides support to students who have been identified as academically disadvantaged. According to the Higher Education Equal Opportunity Act (Act 101), an educationally disadvantaged student is one whose academic preparation and skills are below traditionally acceptable level as determined by the institution in which they are enrolled (Gadsden, 1992). Data for all 30 subjects was included in the analyses of the results.

Materials

Materials used in this study were computer-assisted instructional modules and a posttest. Two computer-assisted instructional modules were created using the HyperCard authoring tool. Each module containing three passages on different content; asteroids, solids, and gases. These modules were based on treatments created by Dr. Roy Clariana. The information was was presented in sections of five screens of text, followed by five multiple choice questions

with four alternatives. This cycle continued for at total of fifteen screens of text and fifteen questions.

The difference between the two instructional methods was the type of feedback (knowledge of correct response or inductive) presented to the learner. Both the Knowledge of Correct Response (KCR) and the inductive feedback treatments were validated by doctoral students in an instructional systems program. In the KCR feedback treatment, the learner recieves the following responses based on the answers they select; "Right!" or "No, Try Again" if their answers are correct or incorrect respectively. While in the inductive feedback treatment, learners either recieve rules or other pertinent information leading to the correct answer if their choice is incorrect or "Right!" if their answer is correct.

In addition to the two computer-assisted instructional modules, a posttest was developed. The postest contained twenty-one questions not previously given in the instructional modules. The posttest was also created by Dr. Roy Clariana. The test consisted of seven questions from each of the three topic areas; solids, gases, and asteroids. The posttest was administered on paper and not via the computer.

Procedure

Before the students arrived to participate in the study, the experimenter prepared the computer laboratory by loading the instructional modules onto the computers. Upon arrival at the computer laboratory, each subject was randomly assigned to one of the two feedback treatment groups and given consent forms to read and sign. Both of the feedback treatments (KCR and inductive) were present at each experimental sessions.

After the subjects read and signed the consent forms, the experimenter explained how to navigate through the computer-assisted instructional module. Subjects were told that the instructional module was intended to examine the effects of using computer-assisted instruction. The subjects were not informed of any differences in the instructional modules. After this brief explaination, each subject proceeded through their instructional module.

Upon completion of the computer-assisted instructional module, the subjects were asked to complete a print-based multiple-choice posttest. Subjects were given as much time as they needed to complete the instructional module and the posttest, but most subjects usually took from forty-five to sixty minutes to complete the instuctional module and the posttest.

Research Design & Analysis

The design of this study was a Posttest-Only Control-group design with two treatment (KCR and inductive feedback). The problem solving ability of the student was tested by have the student use inductive reasoning to correctly answer both treatment and posttest questions. The dependent variable was problem solving ability of the subjects which was represented by the posttest. The independent variables were the types of feedback and the academic classification of the subjects as being academically 'at-risk'. The data in this design was analyzed by performing a t-test to look at the effects of the type of feedback on posttest scores.

Results

For this study, a t-test was performed to determine significant effects of the feedback type on posttest scores. The mean scores for the 21 item posttest was 14.4 for the KCR treatment and 13.95 for the inductive treatment. Analysis of the posttest data had no significant effect on performance, $p > .05$. There was also no significant effect on performance from the treatment test, $p > .05$. Subjects who recieved the inductive feedback did not perform better than those who recieved the KCR feedback.

Discussion

The purpose of this study was to investigate the effect of knowledge of correct response and inductive feedback on the problem solving ability of academically disadvantaged students. The results of this study suggest that subjects were not significantly affected by the implementation of KCR or inductive feedback.

The reason why no significant effects showed up in the analysis of the posttest scores could be the positioning of the feedback. Through out the treatments the feedback was given to the subjects after an incorrect response. The intention of this study was that subjects would learn to solve problems through inductive reasoning by being exposed to inductive feedback. But if the subject gets an answer correct, no feedback is encountered.

Although no significant effects were found in this study, there are some implications for future research on feedback. Future

studies should explore the use and placement of feedback in computer-assisted instruction. Furthermore, future research should examine the long-term effects of the continued use of different types of feedback on the problem solving abilities of academically disadvantaged students.

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